Annals of Glaciology 1996 vol.23, pages X2-35

A simplified multi-scale model for predicting climatic variations of the ice-sheet surface elevation in central Antarctica

Salamatin A., Ritz C.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The equation describing the surface evolution of a large ice sheet is examined on the basis of a scale analysis applied to Antarctic conditions. Changes in the surface elevation are mainly driven by mass-balance fluctuations which approximately follow global atmospheric temperature variations. The essential spatial non-uniformity of the accumulation rate and the resultant difference between central and coastal regions in reaction time-scales are taken into account. The dynamic interaction of the time-lagging interior with the quasi-stationary margin is described. As a result, a simplified model is deduced to simulate the surface-elevation variations in the central parts of the Antarctic ice sheet caused by mass-balance perturbations corresponding to the main Milankovich cycles with the periods of 19-100 kyears. Special computational tests are performed to validate the model through inter-comparison with the predictions obtained with a two-dimensional thermomechanical model. The sensitivity of the model to physical factors (represented by dimensionless tuning parameters) is discussed. Climatically controlled variations of the ice-sheet thickness in the vicinity of Vostok Station during the past 200 kyears are estimated.